Tanta University
Faculty of Engineering
Final Examination
Academic Year: 2010-2011

Department: Mechnical Power Eng.
Year: Second
Subject/Code: Power Electronics
Time Allowed: 3hours
Date: 22/6/2011

Answer all the following questions

Question (1)

a) Draw the power stages (diagram) for d.c generator and d.c motor

b) A 30 kw, 300V, d.c shunt generator has armature and field resistances of 0.05 Ω and 100 Ω respectively. Calculate the total power developed by the armature when delivers full output power.

c) A 440 shunt motor has an armature resistance of 0.08 Ω and field resistance of 200 Ω. Determine the back e.m.f when giving an output of 7.46 kw at 85% efficiency.

Question (2)

a) show that the E.M.F equation of the transformer is

$$E_1 = 4.44 f N_1 \phi_m$$

$$E_2 = 4.44 f N_2 \phi_m$$

b) A 300 KVA transformer has core losses of 1.5 kw and full load copper loss of 4.5 kw. Calculate its efficiency for 75% and 125% of full load output at unity power factor.

c) A 100 KVA lighting transformer has a full load loss of 3 kw, the losses equally divided between iron and copper. During a day, the transformer operates on full-load for 3 hours, one half load for 4 hours, the output being negligible for the reminder of the day, calculate the all-day efficiency.

Question (3

a- Describe with simple drawings the construction and the principle of operation for synchronous generator (alternator).

b- Draw the phasor diagrams of a loaded alternator for unity and lag power factor.

c- A 500 KVA, 1100V, 50 Hz, Y connected, 3phase alternator has armature resistance /phase of 0.1 Ω and synchronous reactance/phase of 1.5 Ω. Find its voltage regulation for unity power factor.

انظر باقي الاسئلة

Question (4

a) Describe with simple drawings the construction and the principle of operation for induction motor.

b) Draw the speed torque characteristics for 3-phase induction motor and list its advantages.

C) A 3-phase induction motor its wound for 4-poles and is supplied from a 50 Hz system. Calculate (i) synchronous speed

(ii) speed of rotor when slip is 4%

Good luck



Electrical Power and Machines Department



TANTA UNIVERSITY

Faculty Of Engineering

Final EXAM 2011/2012 - Second Term

Course	Electrical Machines (EPM2245)	Time Allowed	3 hours
Students	2nd Year (Mechanical Power Engineering)	Total Mark	85
Date	13/6/2012	Number of pages	2

Answer ALL the following questions:

The first question (17 marks)

A	Draw the power flow diagram for d.c generator.
B	A 4 pole, lap wound 750 r.p.m. d.c. shunt generator has an armature resistance of 0.4 ohm and field resistance of 200 ohm. The armature has 720 conductors and the flux per pole is 30 mWb. If the load resistance is 15 ohm, determine the terminal voltage.

The second question (17 marks)

A	Explain the various methods of speed control of d.c shunt motor.
B	A 250 V d.c. shunt motor has a shunt field resistance of 200 ohm and an armature resistance of 0.3 ohm. For a given load, motor runs at 1500 r.p.m. drawing a current of 22 A from the supply. If a resistance of 150 ohm is added in series with the field winding, find the new armature current and the speed. Assume load torque constant and magnetization curve to be linear.

The third question (17 marks)

A	Explain the short circuit test and open circuit test on transformer. Why these tests are to be performed?
B	A 5KVA, 500/250 V, 50 Hz, single-phase transformer gave the following readings, Open circuit test : 500 V, 1 A, 50 W (L.V. side open) Short circuit test : 25 V, 10 A, 60 W (L.V. side shorted) Determine a- The efficiency on full load, 0.8 lagging power factor. b- The voltage regulation on full load, 0.8 leading power factor. c- The efficiency on 60% full load, 0.8 leading power factor. d- Draw the equivalent circuit referred to primary and insert all the values in it.

The fourth question (17 marks)

A	Explain the various types of starters used in case of three-phase induction motor.

B	A 37.3 kW, 4 pole, 50 Hz induction motor has friction and windage losses of 3.32 kW. The stator losses equal the rotor losses. If the motor is delivering full load power output at a speed of 1440 r.p.m. calculate synchronous speed, slip, mechanical power developed by the motor, rotor copper loss, power transferred from stator to rotor, stator power input and efficiency.
The fifth question (17 marks)	
A	Discuss the methods used for starting single-phase induction motors.
B	A three-phase, 14 KV, 10 MVA, 60 Hz, two-pole, 0.85 PF lagging, star-connected, synchronous generator has X_s = 20 ohm per phase and R_s = 2 ohm per phase. The generator is connected to infinite bus. (a) Determine the excitation voltage at the rated condition. Draw the phasor diagram for this condition. (b) Determine the torque angle at the rated condition. (c) If the field current is kept constant determine the maximum power the generator can supply. (d) For the condition in part (c), determine the generator current and the power factor. Draw the phasor diagram for this condition. Neglect Rs for parts (c) and (d).

Good Luck and best wishes

Dr. Abd El-Wahab Hassan





Electrical Power and Machines Department



TANTA UNIVERSITY **Faculty Of Engineering**

Final EXAM 2012/2013 - Second Term

Course	Electrical Machines (EPM2245)	Time Allowed	3 hours
Students	2nd Year (Mechanical Power Engineering)	Total Mark	85
Date	30 / 5/2013	Number of pages	2

Answer ALL the following questions:

The first question (17 marks)	
A	Explain the load characteristic of D.C shunt generator.
B	A dc series generator has an armature resistance of 0.5 ohm and series field resistance of 0.03 ohm, it drives a load of 50 A. if it has 6 turns/coil and total 540 coils on the armature and is driven at 1500 rpm, calculate the terminal voltage at the load. assume 4 pole lap type winding, flux per pole as 2 mWb and total brush drop as 2 V.
The second question (17 marks)	
A	Why a dc series motor cannot be started on no load.
B	A 500 V d.c. shunt motor takes a current of 5 A on no load. The resistance of the armature and field circuit are 0.5 ohm and 250 ohm respectively. Calculate the efficiency when the motor takes a current of 100 A.
The third question (17 marks)	
A	Explain the short circuit test and open circuit test on transformer. Why these tests are to be performed?
B	A 5KVA, 500/250 V, 50 Hz, single-phase transformer gave the following readings, Open circuit test : 500 V, 1 A, 50 W (L.V. side open) Short circuit test : 25 V, 10 A, 60 W (L.V. side shorted) Determine a- The efficiency on full load, 0.8 lagging power factor. b- The voltage regulation on full load, 0.8 leading power factor. c- The efficiency on 60% full load, 0.8 leading power factor. d- Draw the equivalent circuit referred to primary and insert all the values in it.
The fourth question (17 marks)	
A	Which of the following statements are correct? You can write down in your answer sheet the question number followed by either √ or X mark.

بقية الأسئلة بالخلف

	1- the speed of three-phase induction motor is the same of rotating magnetic field produced in its stator winding 2- the slip of three-phase induction motor cannot be zero 3- at maximum efficiency of three-phase induction motor the variable loss = constant loss 4- when the rotor resistance of three-phase induction motor is increased the starting torque decrease 5- when the rotor resistance of three-phase induction motor is increased the maximum torque decrease
B	The power input to a 500 V, 50 Hz, 6 pole, three-phase induction motor running at 975 rpm is 40 kW. The stator losses are 1 kW and friction and windage losses total 2 kW. calculate : a- the slip b- the rotor copper losses c- the output horse power d- the efficiency
<u>The fifth question</u> <u>(17 marks)</u>	
A	Discuss the methods used for starting single-phase induction motors.
B	A three-phase, 11 KV, 1000 KVA, 60 Hz, two-pole, star-connected, synchronous generator has X_s = 3 ohm per phase and R_s = 0.4 ohm per phase. The generator operates at full load with 0.8 lagging power factor. (a) Determine the excitation voltage at the rated condition. Draw the phasor diagram for this condition. (b) Determine the torque angle at the rated condition. (c) the voltage regulation at this load

Good Luck and best wishes
Dr. Abd El-Wahab Hassan



Electrical Power and Machines Engineering Department



TANTA UNIVERSITY **Faculty Of Engineering**

Final EXAM 2013/2014 - Second Term

Course	Electrical Machines (EPM2245)	Time Allowed	3 hours
Students	2nd Year (Mechanical Power Engineering)	Total Mark	85
Date	12 / 6 / 2014	Number of pages	1

Answer ALL the following questions:

The first question (25 marks)

a	Draw the power flow diagrams for d.c generator and d.c motor.
b	Explain the load characteristic of D.C compound generator.
c	Explain the characteristic of d.c shunt motor.
d	Write the various methods used for starting of three-phase induction motor.
e	Draw the phasor diagram of three-phase synchronous generator at lag power factor, lead power factor and unity power factor.

The second question (20 marks)

a	A 4 pole, lap wound 750 r.p.m. d.c. shunt generator has an armature resistance of 0.4 ohm and field resistance of 200 ohm. The armature has 720 conductors and the flux per pole is 30 mWb. If the load resistance is 15 ohm, determine the terminal voltage
b	A DC series motor has the following data: Armature resistance = 1.5 ohm, series field resistance = 2.5 ohm, supply voltage = 300 Volt, mechanical losses =300 W, if the input power is 6 KW at 3000 R.P.M, find the motor's efficiency.

The third question (20 marks)

A 5KVA, 500/250 V, 50 Hz, single-phase transformer gave the following readings,
Open circuit test : 500 V, 1 A, 50 W (L.V. side open)
Short circuit test : 25 V, 10 A, 60 W (L.V. side shorted)
Determine

a- The efficiency on full load, 0.8 lagging power factor.
b- The voltage regulation on full load, 0.8 leading power factor.
c- The efficiency on 60% full load, 0.8 leading power factor.
d- Draw the equivalent circuit referred to primary and insert all the values in it.

The fourth question (20 marks)

A 480 V three-phase induction motor is drawing 60 A line current at 0.85 power factor lagging. The stator copper losses are 2000 W, the core losses are 1800 W, the rotor copper losses are 700 W and the friction and windage losses are 600 W. draw a power flow diagram indicating the following quantities:

a- The air gap power
b- The developed (converted) power
c- The output power (shaft power)
d- The efficiency of the motor
e- The slip

Good Luck and best wishes
Dr. Abd El-Wahab Hassan

Sheet No. 2 (DC generator)

1- A 4 pole, lap wound 750 r.p.m. d.c. shunt generator has an armature resistance of 0.4 ohm and field resistance of 200 ohm. The armature has 720 conductors and the flux per pole is 30 mWb. If the load resistance is 15 ohm, determine the terminal voltage.

2- A wave wound, 6 pole long shunt compound d.c generator has 600 armature conductors. The generator is driven at 300 r.p.m. calculate the e.m.f. generated if the flux per pole is 0.06Wb. If now, the generator is required to produce e.m.f of 550 V at reduced value of flux per pole of 0.055 Wb, calculate the speed at which the armature of the generator must be driven.

3- A four pole, lap wound long shunt compound generator has 1200 armature conductors. The armature, series field and shunt field resistances are 0.1 ohm, 0.15 ohm and 250 ohm respectively. If the flux per pole is 0.075 Wb. calculate the speed at which the machine should be driven so that it can deliver the load of 50 Kw at 500 V. take overall voltage drop due to brush contact as 2 volts.

4- A dc series generator has an armature resistance of 0.5 ohm and series field resistance of 0.03 ohm, it drives a load of 50 A. if it has 6 turns/coil and total 540 coils on the armature and is driven at 1500 rpm, calculate the terminal voltage at the load. Assume 4 pole lap type winding, flux per pole is 2 mWb and total brush drop is 2 V.

5- A 400 V, shunt generator has a full-load current of 200 A, its armature resistance is 0.06 ohm and field resistance is 100 ohm. The stray losses are 2000 W. Find the power input to the generator at full load and the load current for which the efficiency of the generator is maximum.

Sheet (2)
D.C. Motor

1. A 3.37kW, 1725rpm, l25VJthunt motor has an efficiency of 82.5% at full load
Calculate the power input, line-current & output torque.

2. A 250V series motor has an armature & field resistance of 0.06Ω & 0.025 respectively.
The motor draws a line current of 25A when running at 850rpm.
Calculate the speed when the line current is 18A, for the same supply voltage.

3. A shunt motor, with an armature resistance of 0.1Ω, runs at 1000rpm. The supply voltage is 250V & the field resistance is 250Ω. The input power is 6.5kW.
The supply voltage is reduced to 230V & the field resistance is reduced to 125Ω.
Find the new speed to keep the motor torque constant.

4. A series motor has 0.lΩ & 0.05Ω armature & field winding respectively. When the supply voltage is 600V & the motor current is 150A, the motor speed is 3000 rpm. What resistance should be inserted in series to reduce the speed to 2000rpm without affecting motor torque. Neglect saturation.

5. A series motor has 0.1Ω & 0.1Ω armature & field resistance respectively, running at 400rpm. The input power is 60 kW at 500V. If the supply voltage is reduced to 400V & a series resistance of 2.5 Ω is inserted between the motor & supply such that the torque is halved, find the new speed.

6. A 250V shunt motor has a shunt field of 250Ω & an armature resistance of 0.25Ω. For a given load torque, the motor runs at 1500 rpm drawing an armature current of 20A. If a resistance of 250Ω is inserted in series with the field, the load torque remains the same. Find the new speed & armature current.

7. The armature winding of a 200V shunt motor & the shunt field resistance are 0.1Ω & 400Ω respectively. When the motor draws a supply current of 10A, the rotational loss is 100W & the speed is 400rpm. Find:

a) The developed power.
b) The net output power.
c) The motor efficiency.
d) The net output torque.
e) If the flux is halved while the armature current is maintained constant. Find the new speed for the same supply voltage
f) If the torque is doubled, find the new speed for the same supply voltage.

8. A 2-poles D.C. motor runs at 707r.p.m. when taking 100A at 85V with the field coils in series. The resistance of each field coil is 0.03Ohm and that of the armature 0.04Ohm. If the field coils are connected in parallel and load torque remains constant, find:
   a) Speed
   b) The additional resistance to be inserted in series to restore the speed to 707r.p.m.

9. A series D.C. motor runs on 440V circuit with a series-regulating resistance of R Ohm for speed adjustments. The armature and field coils have a total resistance of 0.3Ohm. On a certain load and R=zero, the armature current is 20A and the speed is 1200r.p.m. With another load and R=3Ohm, the current is 15A. Find the new speed. And if the flux in the first case w[illegible]mWb, find the output power and the torque of the motor in each case (O/P power without the mechanical loss=Ea*Ia)

10. A shunt motor runs at 1200r.p.m. on a 420Volt circuit and current taken is 30A in addition to the field current. What resistance must be placed in series with armature in order that the speed may be reduced to 600r.p.m. the current through the armature remaining the same? Assume an armature resistance of 3Ohm.

Sheet (3)
Single phase Transformer

1) A single phase transformer rated 220/240V, 50Hz has an equivalent resistance
(Req) & reactance (Xeq) referred to the primary side equal to 0.02Ω & 0.2Ω respectively The open circuit test at 220V gave a no load current of 1.8A & a no load power of 39.6W The transformer is feeding a 3kW, 0 8 lagging Power factor load at 440V. Calculate the efficiency & voltage regulation of the transformer

2) A 1100/110V step down single phase transformer has the following parameters.
Rc= 2KΩ, Xm= 1.5 KΩ, R_1=4Ω, X_1=3 Ω, R_2=0.04 Ω, X_2=0.03 Ω
If the transformer delivers its output to a load of 5.5 kVA with 0 8 lagging power factor at 110V Calculate ‘
a) The primary voltage
b) The voltage regulation
c) The transformer efficiency

3) A single, phase 440/1 1OV, 50Hz transformer has the following parameters:
Rc=500 Ω, Xm=l000 Ω, R1=0.6 Ω, X1=0.4 Ω, R2=0.2Ω, X2=0.1Ω If the transformer feeds a 1kW load with 0.8 lagging power factor at 110V Calculate the transformer efficiency

4) A 10kVA, 220/110V transformer has the following parameters
R_1=0.02 Ω X_1=0.04 Ω
R_2=0.01 Ω X_2=0.01 Ω
Rc=200 Ω Xm=300 Ω
If the transformer is supplying 75% of its full load at unity power factor & rated secondary voltage, Find:
a) The transformer referred circuit parameters
b) The voltage regulation
c) The transformer efficiency

5) A 5KVA, 500/250 V, 50 Hz, single-phase transformer gave the following readings,
Open circuit test : 500 V, 1 A, 50 W (L.V. side open)
Short circuit test : 25 V, 10 A, 60 W (L.V. side shorted)

Determine

a- The efficiency on full load, 0.8 lagging power factor.
b- The voltage regulation on full load, 0.8 leading power factor.
c- The efficiency on 60% full load, 0.8 leading power factor.
d- Draw the equivalent circuit referred to primary and insert all the values in it.

Sheet (4)
Induction Motor

1. A 40hp, 3300V, 50Hz, 4 poles 3-phase, star connected induction motor has a slip of 2% & a power factor of 0.8 lagging at full load. The stator copper losses, core losses & mechanical losses are 1000W, 1500W & 1200W respectively.

(1hp = 746W).

At full load, determine:

a) The motor speed
b) The line current
c) The rotor copper losses
d) The motor efficiency.

2. A 3-phase, 500V, 50Hz, 6-pole, star connected induction motor develops (net outputs) 20hp at 950rpm with power factor 0.85 lagging The mechanical losses are lhp & total stator copper losses are 1500W (Neglect core losses)

Calculate for these loads:

a) The slip
b) The rotor copper losses
c) The line current

3. A 3-phase, 50Hz, 80hp, 4-pole, star connected induction motor operating at rated conditions has an efficiency of 90%

The core losses, stator copper losses & rotor copper losses are 1500W, 2000W & 1400W respectively. Determine:

a) Input power
b) Air gap power
c) Shaft speed

4. A 3-phase, 400V, 50Hz, 6-pole, star connected induction motor develops (net outputs) 20hp at 950 rpm with pf 0 85 lag. The total mechanical losses are 750W, core losses are 500W & stator copper losses are 1000W .Calculate for these loads:

a) The slip
b) The rotor copper losses
c) The line current

5. A 3-phase, star connected, 50Hz, 6-pole, 380V induction motor running at 50rpm, has a net output torque of 25Nm. If the stator copper losses

& core losses are 350W, mechanical losses are 250W & input power factor is 0.7 lag Calculate:

a) The slip, rotor copper losses & air gap power
b) The input line current & motor efficiency

6. A 3-phase, 20hp, 500V, 50Hz, 6-pole, star connected induction motor running at 950rpm with 0.85 lagging power factor. The mechanical losses are 1hp, the stator copper losses are 1500W, while the core losses are 500W. Calculate:

a) The rotor copper losses
b) The line current
c) Motor efficiency

Sheet (5)
Synchronous Generator

1. A 3-phase, 8-pole synchronous, generator is star connected. The stator has 168 slots with 9 conductors per slot. If the rotor speed is 750rpm, estimate the flux required in the air gap to generate an e.m.f of 1000V between lines.
   (Winding factor = 0.96).

2. In a 50kVA, star connected, 440V, 3-phase, 50Hz alternator. The armature resistance is 0.25/phase. The armature reactance is 3.7/phase. Determine at rated load & unity power factor, the induced e.m.f. per phase & voltage regulation. Sketch the phasor diagram.

3. A 3-phase alternator is rated at 5kW, 1 1OV, 29A lagging power factor, 50Hz & 1000rpm The stator resistance is 0.1/phase & armature reactance is 1.53/phase
   The field current is I_{fl} (full load current)
   a) Find the no load induced m f, voltage regulation & number of poles
   b) If the field current is reduced to (0.9 I_{fi}) while the speed is kept constant, what would be the load voltage if the generator is supplying the load with the same load current at the same power factor.
   c) If the speed, field current & load current are kept constant, the power factor is changed to 0.8 leading, what would be the terminal voltage?

4. A 3-phase, star connected, 6-pole synchronous generator supplies a 3-phase load of 100kW, 0.8 leading power factor at 60 Hz, 2kV line voltage. The machine per phase armature resistance & reactance are 0.4Ω & 4Ω respectively Find :
   a) Voltage regulation
   b) Maximum developed power
   c) Efficiency if P_r =10kW

5. A 40kVA, 380V, 4-pole, 50Hz, star connected, 3-phase synchronous generator has per phase armature resistance of 0.04Ω & armature reactance of 0.42Ω. The generator has 100 turns per phase Determine :
   a) The generated e.m.f voltage (Eph) at full load with 0.8 lagging pf
   b) The full load voltage regulation
   c) The generator driving speed
   d) The flux per pole

6. A 9kVA, 208V, 1200rpm, 3-phase, 6OHz, star connected, synchronous generator ; a field winding resistance of 4.5Ω. The armature winding impedance is 0 3+j5 Ω/phase.
When the generator operates at its full load & 0.8 pf lagging, the field winding current is 5A. The rotational loss is 500W. Determine:
a) The voltage regulation.
b) The efficiency of the generator.
c) The torque applied by the prime mover.